Illuminating the trans-mediation process: an eye-tracking study of sketching to light painting in design education

Keyur Sahasrabudhe
Symbiosis Institute of Design, Symbiosis International (Deemed University), Pune, India

Gagan Prakash
Symbiosis Institute of Design, Symbiosis International (Deemed University), Pune, India and SSVAP, Symbiosis International (Deemed University), Pune, India

Sophia Gaikwad
Symbiosis Institute of Design, Symbiosis International (Deemed University), Pune, India and STLRC, Symbiosis International (Deemed University), Pune, India, and

Vijay Shah
School of Design, DY Patil College of Engineering Akurdi, Pune, DY Patil International University, Pune, India

Abstract

Purpose – This study is an “Action-Research-based” bridge that connects sketching and photographic processes. The article’s objective encompasses designing, assessing and validating a perceived difference between sketching and photography through a structured task by ensuring the systematic creation and implementation of the assignments. This study is part of a larger research project exploring the differences between thinking about sketching and final photographic outcomes.

Design/methodology/approach – This experimental mixed-method methodology was collected in three phases: the creation phase, where participants were asked to sketch and photograph a balanced composition; the evaluation phase, where the sketches and photographs were evaluated by “Self, Peer, and Independent” reviewers for their perceived differences. An analysis of variance (ANOVA) was implemented to test the result. In the validation phase, eye-tracking technology is applied to understand the subconscious eye movements of individuals.

Findings – This study of 37 samples has helped develop a self-study model in photography, as students have learnt to evaluate themselves critically. This experience will help students be active and reflective learners, thus increasing attention and retention in their course, specifically “Photography Design Education”. A pedagogical approach by design instructors for practical, student-friendly, process-oriented assignments for their photography courses in higher education.

Originality/value – The trans-mediation process requires cognition amongst different mediums, such as pencil and paper for sketching and light for light painting. Photography courses in design education need knowledge of the photo/light medium, contrasting with the understanding of sketching/drawing. Exploring

We would like to express our sincere gratitude to the Symbiosis Institute of Design for allowing us to research photography design education. We sincerely thank Dr Aradhana Gandhi, the Symbiosis Centre for Behavioural Studies (SCBS) professor. Your expertise in eye-tracking was instrumental in shaping the direction of this work. We would also like to thank Dr Punit Kumar Mishra of Symbiosis Centre for Management Studies (SCMS) for guiding us in the statistical analysis.

Since submission of this article, the following author(s) have updated their affiliation(s): Vijay Shah is at the Symbiosis Institute of Design, Symbiosis International (Deemed University), Pune, India.
and addressing research gaps for transforming and designing assignments based on adaptive understanding presents an exciting opportunity.

**Keywords** Action research, Visual communication, Design education, Photography, Sketching, Eye-tracking

**Paper type** Research paper

1. Introduction

Over the past few years, the realm of design education has witnessed a notable difference in the execution of photography projects amongst students at our esteemed institute, igniting a critical examination of the process involved. This investigation is part of border action research (Adelman, 1993), an initiative seeking the nuances between the preparation sketching and the eventual photographic outcome (Camacho and Alexandre, 2019). As we dive deep into this study, we aim to explore the epistemic differences between these creative mediums but also look forward towards a specialised photography course explicitly tailored for design students (Kemmis et al., 2014; Makowska, 2019; Nead, 2005; Tschimmel, 2011; Verma and Punekar, 2023), this study is significant for research and is the need of the hour.

The intersection between sketching and photography in design education is critical for navigating the complexity of transitioning conceptual sketches to photographic composition (Chuang and Tang, 2019). Perception is subjective and influenced by individual differences, experiences, culture and beliefs (Daouk et al., 2016; Tschimmel, 2011; Zakia, 2013). This study helps decipher the intricacies of design processes that can significantly enhance the andragogy approach towards design education.

This study compares the visual perception differences between sketches and photographs, focussing on “SHAPE, FORM, LIGHT and SHADE” (Cate and Behrmann, 2010). The study examines accuracy, realism, composition, detail, clarity, light and shadow, texture and technical skills (Ocvirk et al., 2014). Both sketches and photographs are depicted in black and white, eliminating colour perception. The absence of colour provides a unique opportunity to analyse the results in a limited way, as this area has yet to be thoroughly studied.

A comprehensive review of the existing literature has underscored the necessity of conducting a triangulation method (Adelman, 1993; Wood, 2019) by an in-depth comparative analysis, which involves both subjective review methods, such as “SELF, PEER and INDEPENDENT – review assessment” and objective review techniques, that include eye-tracking (Arneson and Offerdahl, 2018; Krathwohl, 2002). To achieve this, we pose the following research questions:

**RQ1.** How do we perceive differences between sketching and photographing the same composition?

**RQ2.** What parameter is responsible for the difference between a sketch and a photograph of the same composition?

**RQ3.** How can eye-tracking technology enrich understanding of the cognitive processes of sketching and photography?

This study combines and compares sketching and photography to develop a new approach to design education. Findings will be used to create a handbook to explore the photography process based on design, education and management models, namely, the design-thinking process EDIPT (E-empathise, D-define, I-ideate, P-prototype, T-test), Bloom's taxonomy and AIDA (A-awareness, I-interest, D-desire, and A-action), which are comprehensive to photography projects (Hassan et al., 2015; Krathwohl, 2002; Verma and Punekar, 2023).

This paper unfolds five sections. Section 2 reviews the literature and discusses the need for a novel exploration of the intersection between sketching and photography. Section 3 outlines the research methodology, explaining the rationale behind the chosen approach. Section 4 presents the data collection and analysis, aligning findings with established models in theory
and practice. The paper concludes in Section 5 with a discussion of limitations and propositions for future studies.

2. Review of literature
This section critically examines past research from the lens of action research in sketching, photography, design education and eye-tracking, laying the essential groundwork for the experimental research. The theoretical framework, encompassing key constructs and variables, is a foundation for the subsequent exploration. The section unfolds as follows (see Table 1):

2.1 Action research as an approach
Action research is employed as a practical approach in photography design education. Whilst the generic model offers a foundation, the Kurt reflective learning model (PAR) (Adelman, 1993; Ord and Leather, 2017), which consists of four stages – planning, action, analysis and conclusion provides a versatile framework adaptable to photography design education. Incorporating micro concepts from other models contributes to the richness of this experimental research (see Figure 1).

2.2 Trans-mediation a media-centric approach
Trans-mediation, as defined by Elleström (2018), involves transitioning between different mediums, such as sketching and photography. Ellestrom developed a “medium-centred model” of communication that works on transferring ideas to different mediums and a profound grasp of higher-order thinking in visual communication. This approach aligns with Bloom’s taxonomy and contributes to understanding higher-order thinking for cognitive, affective and psychomotor domains (Arneson and Offerdahl, 2018) in visual communication and literacy.

2.3 Visual communication as generic
Integrating Visual Communication theory with diverse subjects such as “Visual Literacy, Sketching, Drawing theory, Thinking sketching, Conceptual sketching, Photography, Composition, Aesthetics, Gestalt, and Visual hierarchy” offers a comprehensive perspective. The unified approach incorporates various lenses of understanding and application in visual communication; perception and precision are paramount (Pflaeging and Stöckl, 2021). Despite the paramount importance of these elements, there is a limited exploration of the simultaneous effectiveness of two distinct mediums, Sketching and Photography, in visual communication.

Visual literacy is a vital skill in today’s world, where visual media plays a significant role; it involves teaching students how to interpret analysis and create visual messages.
Integrating visual literacy into teaching and fostering critical thinking, creativity and problem-solving skills leads to meaningful learning (Rapanta et al., 2021; Sailer et al., 2021; Verma and Punekar, 2023). Beyond enhancing the technical prowess available on the Internet and big data (Chakraborty et al., 2023) lies an enormous amount of information that needs to be churned out for research, and it equips students to analyse, interpret images and convey ideas through visuals, enriching their artistic skills (Verma and Punekar, 2023).

2.4 Design education and action research

Today’s education system, whether online or offline, encourages students to communicate orally and textually (Abu Talib et al., 2021; Dash et al., 2022) before fully developing a visual language. As visual language is very subjective, developing visual grammar amongst students of design, in general, to communicate (Chakraborty and Biswas, 2020; Kędra and Żakevičiūtė, 2019) using visual symbiotic language, where activities like thinking and drawing or taking photographs whilst composing, play a part in engaging experiments and reflection aids in understanding how art is trans-mediated between different mediums, involving metacognitive activity (Chuang and Tang, 2019; Dash et al., 2022).

Assessing assignments holds significant responsibility for educators, indicating students’ grasp of the subject matter (Bond et al., 2020; Menéndez-Varela and Gregori-Giralt, 2018). According to Bloom’s taxonomy, the change in behaviour and attitude means education has happened (Chakraborty, 2023; Frey, 2018; Krathwohl, 2002) as rubrics come in various forms: Analytical, Developmental, Holistic and Checklist. Design fundamentals, principles adhering to Gestalt law, underpin rubric creation for assessing images or sketches as investigated by Mathew (2011), have explored design principles in photography to facilitate the understanding of local art by the Indian audience.

2.5 Sketching as action research

Sketching is a process that is incredibly flexible in tweaking and refining, helps to ideate and iterate and is very cost-effective in putting an idea on paper. An artist employs a potent means of
communication and a fundamental process to convey ideas or capture scenes as perceived through their unique perspective (Gallagher, 2017; Johnson et al., 2009). The “SELECTION, SIMPLIFICATION, and SYNTHESIS” guides artists through deliberate choices, complexity reduction and harmonious composition (Chuang and Tang, 2019; Milani and Schoonderbeek, 2010).

2.6 Sketching and photography: an action research approach for design education
Sketching and photography, whilst distinct, yet they share a common goal. Embracing diverse mediums can foster creativity, adaptability and interdisciplinary connections to new artistic forms, art and technology (Bond et al., 2020; Brumberger, 2019) into the creative process and enhances students’ vocabulary of expression. Strong observation skills, developed through persistent practice, facilitate detailed and meaningful representation (Rodgers et al., 2000).

We will discuss the literature review of the research question.

RQ1. How do we perceive differences between sketching and photographing the same composition?

For a designer, sketching involves a meticulous process that includes selecting, simplifying and synthesising ideas to achieve a desired creative output (Milani and Schoonderbeek, 2010; Zakia, 2006, 2013; Zakia and Page, 2011). Visual communication is crucial in both sketching and photography. Although people tend to generalise their differences, the main one is speed. Photography is faster, but both mediums are effective in conveying ideas visually. Table 2 summarises the various action research approaches that can be mapped with the sketching and photography process as generalised.

2.7 Photography as action research
Through experience and practice, photographers adeptly navigate and master interdisciplinary fields, integrating knowledge and applied psychology, particularly in composition, an influential medium of visual communication, effectively reaching the masses (Elkins, 2013; Langford and Bilissi, 2011). In his book Perception and Imaging Photography, Richard Zakia delves into

<table>
<thead>
<tr>
<th>Activities with action research</th>
<th>Sketching</th>
<th>Photography</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scene and planning</td>
<td>Selection</td>
<td>Projection</td>
</tr>
<tr>
<td></td>
<td>• Seeing and looking</td>
<td>• Observation</td>
</tr>
<tr>
<td></td>
<td>• Observation</td>
<td>• Looking for clues</td>
</tr>
<tr>
<td></td>
<td>• Mind eye and hand</td>
<td>• Eye for photograph</td>
</tr>
<tr>
<td></td>
<td>• Practice</td>
<td>• Practice</td>
</tr>
<tr>
<td></td>
<td>• Anticipation grasping</td>
<td>• Anticipation capturing moment</td>
</tr>
<tr>
<td>Action</td>
<td>Simplification</td>
<td>Introduction</td>
</tr>
<tr>
<td></td>
<td>• Anticipation grasping</td>
<td>• Anticipation capturing moment</td>
</tr>
<tr>
<td></td>
<td>• Objectivity artist skills</td>
<td>• Instrumentality</td>
</tr>
<tr>
<td></td>
<td>• Reductionist</td>
<td>• Reductionist</td>
</tr>
<tr>
<td></td>
<td>• representation</td>
<td>• representation</td>
</tr>
<tr>
<td>Reflection and conclusion</td>
<td>Synthesis</td>
<td>Confluence</td>
</tr>
<tr>
<td></td>
<td>• Composition</td>
<td>• Composition</td>
</tr>
<tr>
<td></td>
<td>• Skills and practice</td>
<td>• Skills and patients</td>
</tr>
<tr>
<td></td>
<td>• Thinking and drawing</td>
<td>• Communication and science</td>
</tr>
<tr>
<td></td>
<td>• Aesthetic pleasure</td>
<td>• Aesthetic pleasure</td>
</tr>
<tr>
<td></td>
<td>• Perception direct and indirect</td>
<td>• Perception direct and indirect</td>
</tr>
</tbody>
</table>

**Source(s):** Author’s own work. Berger (1977), Loomis (2017), Milani and Schoonderbeek (2010), Zakia (2013) and Zakia and Page (2011)

2.8 Eye-tracking system in the experiment
The experimental study involved the eye-tracking method and the questionnaire, as eye-tracking is a tool for visual communication, advertising and film appreciation (Joseph and Murugesh, 2020) for plotting fixation, saccades and regression within the images. The eye-tracking system is employed to understand and verify the area of interest (AOI) within the image for the sketch and photograph of the same composition. This objective method will confirm the perception between the sketch and photograph.

2.9 Research gap discussed
The existing literature reveals a significant research gap in understanding action research in photography project planning, from thinking sketches to project execution to the final photographic outcome. The experimental action research proposed in this study aims to fill this gap and provide valuable insights for design colleges. The emphasis on self-exploration and reflection through a derived task sheet adds a practical dimension to the theoretical contributions of this research.

3. Research methodology
This section delineates a tripartite structure comprising the “Creation, Evaluation and Validation Phase”, thereby establishing a triangulated research methodology. This methodological framework encompasses subjective and objective data collection and analysis and culminates in a comprehensive discussion section.

The experiment was carried out at the design institute, with student participation being entirely voluntary, allowing them to withdraw from the experiment at any point. Of the initial cohort of 47 participants, data from $N = 37$ individuals (Table 3) underwent further scrutiny for analysis. Six participants could not complete the creation phase in 30 min and four had taken the first photograph and started sketching; thus, they were disqualified from the experiment. The qualified group consisted of 11 males and 26 females.

3.1 Creation phase
Participants assembled in six groups and were instructed to select three objects from a diverse pool of objects to construct a well-balanced composition. They were given drawing paper and informed half an hour to complete the task. Subsequently, participants had to photograph their composition from the same angle they had used for drawing. In the drawing/sketching process, 54% adhered to conventional still-life sketching methods; this involved keeping the sketchbook parallel to the object erect whilst taking hand length measurements for proportion, shape and perspective. Using monochromatic grayscale in drawings and images was a deliberate methodological choice to minimise subjectivity.

<table>
<thead>
<tr>
<th>SR No.</th>
<th>Sex</th>
<th>Participant at start</th>
<th>Participant at end ($N$)</th>
<th>% at start</th>
<th>% at end</th>
<th>Std method of sketching</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>15</td>
<td>11</td>
<td>31.9</td>
<td>29.7</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>32</td>
<td>26</td>
<td>68.1</td>
<td>70.3</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>47</td>
<td>37</td>
<td>100%</td>
<td>100%</td>
<td>54%</td>
</tr>
</tbody>
</table>

Table 3. Sample demographic
Source(s): Authors’ own work
3.2 Evaluation phase
Participants evaluated photographs and sketches based on “SHAPE, FORM, and LIGHTING”. They conducted Self, Peer and Independent evaluation using a 10-point rubric scale, where 1 indicated the maximum difference and 10 represented the minimum difference; this approach, aligned with established practices (Brookhart, 2018), aimed to gauge disparities between the two mediums. An independent senior faculty member, familiar with the parameters, conducted a parallel review of the data set.

3.3 Validation phase
The representative sample for eye-tracking analysis was identified as the statistical median from the data all-average of “PEER, SELF, and INDEPENDENT” review assessments. Two samples (Images of sketches and photographs) were selected for eye-tracking; they were the median (Table 4) of the dataset, and eye-tracking conclusions were drawn from two sample images (Puhalla, 2008). According to the AOI, subconscious eye movement and fixation are the most effective evaluation criteria for assessing the difference between sketches and photographs (Tang, 2020). Eye-tracking technology compares objective evaluations (eye-tracking and independent opinions) of sketching and photography.

4. Data collection and analysis
Data encompassing Sketches and Photographs were gathered from all the participants through Google Forms, including all types of reviewers’ evaluations on the Likert scale with responses, elucidating perceived differences. Microsoft 365 Excel served for ANOVA and data management. For validation purposes, Tobii eye-tracking system version 3.4.5 was employed. From the computed average (Table 4), two representative images were meticulously chosen for the eye-tracking system. CODE - 17441 and 01221 images were selected as the final images (Table 4 Sr. no. 4 and 16) for the eye-tracking experiment as its median = 6.11, showing the central tendency. Noteworthy, these final images, comprising both sketches and photographs, were rendered in grayscale for consistency, totalling four images.

4.1 Data analysis using ANOVA for the perceived differences between sketches and photography

RQ2. What parameter is responsible for the difference between a sketch and a photograph of the same composition? This study explores the perceived disparities in conveyed meaning between sketching and photography, and the various hypotheses are as follows:

H1. There is a perceived difference between the exact composition of objects in the sketch and photograph across the review types (SELF, PEER and INDEPENDENT) and for SHAPE parameters.

The ANOVA shows a noticeable difference in ratings between sketches and photographs for the “SHAPE” parameter, with a P-value below 0.05, indicating the rejection of the null hypothesis. The Tukey–Kramer Post-Hoc Test reveals no significant difference in ratings for the “SHAPE” parameter amongst different reviewers. All absolute mean differences fall within the critical Q value of 0.900, indicating a consensus amongst reviewers in perceiving no pronounced difference between sketches and photographs regarding SHAPE.

H2. There is a perceived difference between the exact composition of objects in the sketch and photograph across the review types (SELF, PEER and INDEPENDENT) and for FORM parameters.
The ANOVA test showed a significant difference in ratings between sketches and photographs for the "FORM" parameter, evaluated by different reviewers. The Tukey-Kramer Post-Hoc Test revealed a significant difference in ratings for the "FORM" parameter between SELF Reviewer and PEER Reviewer. The dataset includes a Q critical value of 0.864, Q of 3.460, S2 pooled of 2.307, a sample size (n) of 37.000, and an AVERAGE of 2.307.

**H3.** There is a perceived difference between the exact composition of objects in the sketch and photograph across the review types (SELF, PEER and INDEPENDENT) and for LIGHT and SHADE parameters.

### Table 4.

Table 4. Data collected from the reviewer’s perception of the difference between sketches and photographs

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>CODE</th>
<th>All average</th>
<th>Independent reviewer</th>
<th>SELF reviewer</th>
<th>PEER reviewer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17261</td>
<td>6.89</td>
<td>5.67</td>
<td>6.00</td>
<td>9.00</td>
</tr>
<tr>
<td>2</td>
<td>17311</td>
<td>5.06</td>
<td>4.50</td>
<td>5.33</td>
<td>5.33</td>
</tr>
<tr>
<td>3</td>
<td>17331</td>
<td>5.89</td>
<td>5.33</td>
<td>6.00</td>
<td>6.33</td>
</tr>
<tr>
<td>4</td>
<td>17441</td>
<td>6.11</td>
<td>6.00</td>
<td>5.33</td>
<td>7.00</td>
</tr>
<tr>
<td>5</td>
<td>17451</td>
<td>5.22</td>
<td>5.00</td>
<td>4.00</td>
<td>6.67</td>
</tr>
<tr>
<td>6</td>
<td>17481</td>
<td>5.89</td>
<td>5.67</td>
<td>6.67</td>
<td>5.33</td>
</tr>
<tr>
<td>7</td>
<td>01011</td>
<td>5.33</td>
<td>5.00</td>
<td>4.67</td>
<td>6.33</td>
</tr>
<tr>
<td>8</td>
<td>01051</td>
<td>5.06</td>
<td>3.50</td>
<td>6.00</td>
<td>5.67</td>
</tr>
<tr>
<td>9</td>
<td>01111</td>
<td>6.50</td>
<td>6.50</td>
<td>5.00</td>
<td>8.00</td>
</tr>
<tr>
<td>10</td>
<td>01131</td>
<td>6.44</td>
<td>6.00</td>
<td>7.00</td>
<td>6.33</td>
</tr>
<tr>
<td>11</td>
<td>01141</td>
<td>5.06</td>
<td>3.50</td>
<td>7.00</td>
<td>4.67</td>
</tr>
<tr>
<td>12</td>
<td>01151</td>
<td>5.61</td>
<td>4.17</td>
<td>4.67</td>
<td>8.00</td>
</tr>
<tr>
<td>13</td>
<td>01161</td>
<td>7.61</td>
<td>8.83</td>
<td>6.67</td>
<td>7.33</td>
</tr>
<tr>
<td>14</td>
<td>01181</td>
<td>7.33</td>
<td>7.00</td>
<td>6.67</td>
<td>8.33</td>
</tr>
<tr>
<td>15</td>
<td>01191</td>
<td>6.50</td>
<td>7.50</td>
<td>7.67</td>
<td>4.33</td>
</tr>
<tr>
<td>16</td>
<td>01221</td>
<td>6.11</td>
<td>7.00</td>
<td>4.33</td>
<td>7.00</td>
</tr>
<tr>
<td>17</td>
<td>01201</td>
<td>6.33</td>
<td>6.00</td>
<td>6.00</td>
<td>7.00</td>
</tr>
<tr>
<td>18</td>
<td>01231</td>
<td>4.78</td>
<td>3.67</td>
<td>3.00</td>
<td>7.67</td>
</tr>
<tr>
<td>19</td>
<td>17303</td>
<td>6.56</td>
<td>6.33</td>
<td>8.00</td>
<td>5.33</td>
</tr>
<tr>
<td>20</td>
<td>17291</td>
<td>7.17</td>
<td>7.50</td>
<td>5.67</td>
<td>8.33</td>
</tr>
<tr>
<td>21</td>
<td>17271</td>
<td>7.11</td>
<td>8.00</td>
<td>6.67</td>
<td>6.67</td>
</tr>
<tr>
<td>22</td>
<td>17321</td>
<td>7.06</td>
<td>8.17</td>
<td>7.00</td>
<td>6.00</td>
</tr>
<tr>
<td>23</td>
<td>17431</td>
<td>4.94</td>
<td>4.50</td>
<td>5.33</td>
<td>5.00</td>
</tr>
<tr>
<td>24</td>
<td>17391</td>
<td>5.22</td>
<td>6.00</td>
<td>2.67</td>
<td>7.00</td>
</tr>
<tr>
<td>25</td>
<td>17401</td>
<td>5.89</td>
<td>5.33</td>
<td>5.00</td>
<td>7.33</td>
</tr>
<tr>
<td>26</td>
<td>01031</td>
<td>4.94</td>
<td>5.17</td>
<td>5.00</td>
<td>4.67</td>
</tr>
<tr>
<td>27</td>
<td>17461</td>
<td>7.72</td>
<td>8.50</td>
<td>6.67</td>
<td>8.00</td>
</tr>
<tr>
<td>28</td>
<td>17361</td>
<td>7.83</td>
<td>7.17</td>
<td>7.33</td>
<td>9.00</td>
</tr>
<tr>
<td>29</td>
<td>17371</td>
<td>6.83</td>
<td>7.83</td>
<td>7.00</td>
<td>5.67</td>
</tr>
<tr>
<td>30</td>
<td>17421</td>
<td>7.22</td>
<td>7.33</td>
<td>5.33</td>
<td>9.00</td>
</tr>
<tr>
<td>31</td>
<td>17251</td>
<td>5.44</td>
<td>5.33</td>
<td>6.00</td>
<td>5.00</td>
</tr>
<tr>
<td>32</td>
<td>01241</td>
<td>5.83</td>
<td>4.50</td>
<td>6.00</td>
<td>7.00</td>
</tr>
<tr>
<td>33</td>
<td>17471</td>
<td>6.39</td>
<td>7.17</td>
<td>5.33</td>
<td>6.67</td>
</tr>
<tr>
<td>34</td>
<td>17341</td>
<td>5.00</td>
<td>6.00</td>
<td>5.33</td>
<td>3.67</td>
</tr>
<tr>
<td>35</td>
<td>17351</td>
<td>5.89</td>
<td>7.33</td>
<td>3.67</td>
<td>6.67</td>
</tr>
<tr>
<td>36</td>
<td>01031</td>
<td>4.78</td>
<td>4.67</td>
<td>5.00</td>
<td>4.67</td>
</tr>
<tr>
<td>37</td>
<td>01071</td>
<td>6.33</td>
<td>6.00</td>
<td>6.00</td>
<td>7.00</td>
</tr>
</tbody>
</table>

**Note(s):** All averages are for representative samples for eye-tracking and ANOVA. The perceived differences between sketch and photograph are based on SHAPE, FORM, LIGHT, and SHADE. The italic values 17441 and 01221 are median and central tendency for the selection of the images that were used for the eye-tracking experiment.

**Source(s):** Authors’ own work
The ANOVA analysis shows a discernible difference in ratings between Sketch and Photograph. There is a significant variance in the ratings for the “LIGHT and SHADE” parameter amongst different reviewers. However, the \( P \)-value of 0.206 and F-value of 1.601 are not statistically significant, supporting the null hypothesis. The Tukey–Kramer Post-Hoc Test also reveals no significant differences in ratings for the “LIGHT and SHADE” parameter amongst different reviewers. The Q critical value of 1.112 and all absolute mean differences below support this conclusion.

\[ H4. \text{ There is a perceived difference between the exact composition of objects in the sketch and photograph across the review types (SELF, PEER and INDEPENDENT) and for ALL PARAMETERS.} \]

The ANOVA analysis indicates a difference in ratings between Sketch and Photograph for the same composition. The Tukey–Kramer Post-Hoc Test identified a significant difference in the average ratings for “SHAPE, FORM, LIGHT and SHADE” between SELF Reviewers and PEER Reviewers. Parameters “SHAPE and FORM” exhibited noteworthy differences between sketches and photographs and amongst Self and Peer reviewers. The holistic assessment of all parameters did not consistently support significant distinctions, highlighting the nuanced nature of the perceived differences.

\[ 4.2 \text{ Survey of text analysis of the experiment} \]

The text compares the “SHAPE” perception between sketches and photographs. Photographs are more detailed and accurate, whilst sketches offer unique qualities like sharper edges. Both mediums may differ in proportionality, size and depth representation. The differences in shape perception are multifaceted and involve considerations of detail, accuracy, distortion, proportionality, depth and consistency.

The survey text compares “FORM” perception between sketches and photographs. Photographs offer accurate proportions and detailed images with lighting shadows, whilst sketches may differ in depth perception, proportion and perspective. Photographs define the form more accurately due to lighting and camera capabilities. Sketches can show less shading and detail contrasts and viewing angles can affect form and distance perception. Overall, sketches need more depth perception and accuracy in form, proportion, size and perspective than photographs. Photographs offer better-defined forms due to lighting and camera capabilities.

Sketches often need more intricate details of LIGHT and SHADE value rendering, including highlights and shadows, which can be observed in photographs due to their higher contrast. Reviewers highlight the differences in light and shade compared with live scenes and photographs and, at the same time, emphasise the need to better represent shadows and highlights in sketches. The differences between sketches and photographs encompass contrast, detailing, accuracy and lighting quality.

\[ 4.3 \text{ Data collection and analysis for eye-tracking} \]

Data collection and analysis using eye-tracking for the differences between Sketches and Photography. From Figures 2–5.

\[ RQ3. \text{ This study delves into how eye-tracking technology can enrich understanding of the cognitive processes engaged in sketching and photography.} \]

The pictures (Figure 2) are the images used for the eye-tracking experiments to unravel the visual hierarchy and AOI inherent for mitigating evaluation biases for central tendency (Table 4) used to derive representative visual stimuli for eye-tracking analysis. Convenient sampling was done using eye-tracking for 30 participants between the ages of 22 and 60. Participants were made comfortable whilst they were introduced to the experiment in a
Figure 2. Representative images for eye-tracking experiment

*Source(s):* Author’s own work

Figure 3. Representative images heat map from eye-tracking experiment

*Source(s):* Author’s own work
dedicated laboratory setting. They were asked to sit erect and look at a particular area of the screen to calibrate the eye-tracking system with their eyes to accumulate data. Participants were asked to go through the slide show and debriefed after the experiment.

Source(s): Author’s own work

Transmediation - photography design education

Figure 4. Gaze plot from representative image for eye-tracking experiment

Figure 5. Cluster map from representative image for eye-tracking experiment
4.4 Eye-tracking results for heat map and gaze plot
In this section about the heat map generated from the eye-tracking data, it is evident that there were more fixations on the photograph compared to the sketch. This fixation suggests that the photograph contains more objects and relevant information near the camera’s field of view. To verify this finding further, we refer to Figure 4, which illustrates the fixation count and gaze plot to form a heat map. The plot shows that the Gaze was spread over additional objects, such as pencils and the watch worn by the person, depicted in both photographs (images C and D).

4.5 Eye-tracking results for cluster map
The Cluster Map (Figure 5) was generated from the representative image for the Eye-tracking experiment, and it is inferred that two specific clusters were created in the photographs compared to sketches. Such significant visual fixation creates a visual hierarchy in the frame, and the visual cues drive the eye to another AOI.

The data gathered from the eye-tracking system revealed that participants viewed only the composition for sketches (Table 5: a and b) by 100 and 97%, respectively. On the other hand, for Photograph (c), Cluster 1 and Cluster 2 were fixated on by 97 and 18% of participants, respectively, whilst picture (b) had Cluster 1 and Cluster 2 fixated on by 97 and 88% of participants respectively. These findings indicate that participants focussed their vision on different AOI than the sketches and were regression within the two clusters in the photographs.

5. Discussion, conclusion, limitation and future action research
This section found that (Table 6) SELF-reviewers were more critical about sketches and photographs; as they were involved in making the sketch and later photographing it, they could identify errors easily. Only for shape as a parameter, the INDEPENDENT reviewer and SELF were equally critical, whereas for other parameters, SELF was more critical and could identify errors and distinguish the difference correctly. The result raises the reflection question at each project stage or the end. Reflecting at the end will be better as the student gets scared about the work that must be redone. If a toolkit is developed and review reflection is initiated between stages, the project will be more accessible and fun. The participants have experienced how and what to look at in the given piece of art; this has helped them develop observational skills (Rodgers et al., 2000). Upon analysing feedback from multiple reviewers,
it became apparent that individuals are more critical when analysing their work than others; this concept of self-evaluation should be a regular part of every assignment (Brookhart, 2018).

Another observation is that the reviewers between the groups could not perceive (Table 6) the difference in form, light and shade as they are interrelated. If the form lacks shadow, it becomes shape. The ANOVA test average for all SHAPE, FORM and LIGHT and SHADE states that there is a perceived significant difference between sketch and photograph due to their property feature of elements of design and their principles affecting the perception (Zakia, 2013). This identification is tricky to understand as it depends on the light, shade and background, so the reviewers could not identify the difference significantly (Ocvirk et al., 2014).

Our experiment successfully highlighted the differences between sketching and photography. Self-reflection is an essential tool for identifying areas of improvement in students. Eye-tracking analysis showed a difference in Gaze on the image between sketch and photograph. This application is helpful for students who want to provide the best solution to clients.

5.1 Limitation
Three factors limited this research experiment: A small sample size of 37 participants was used due to practical constraints and limited resources. The experiment focussed only on monochromatic grayscale images, excluding line, texture and colour effects. The research was conducted within a finite time frame, requiring a balanced approach to achieve well-defined outcomes (Langford and Bilissi, 2011; Zakia, 2013).

5.2 Future direction
As previously discussed, the objective of this research experiment is in two phases. The first phase investigates the perceived difference between sketch and photograph at the beginning and end of each project task. This experimental research also raised questions about what effective combination of process and model would work best from the instruction stage to project completion. Throughout the introspection stages, the learner internalises the process they are going through. In the next phase, future research will investigate the design thinking process for photography projects.

In the PLANNING stage (Adelman, 1993; Sathe and Yu, 2021), the problem is identified and research is conducted on it. After reflecting on the problem, various solutions are found and analysed, and one solution is chosen for implementation in the experiment.

In the ACTION stage, the selected solution is used for the experiment, a methodology is implemented, and the solution is implemented on the samples.

In the ANALYSIS stage (Kass et al., 2013), data is collected in quantitative and qualitative forms, and the reviewer’s perception and reflection determine the perceived difference. Statistical tools are used to analyse the data and descriptive and inferential analyses are conducted.

Lastly, the data is analysed, discussed, or introspected in the CONCLUSION stage. The results are found, and a further alternative plan is developed, complete with a blueprint for testing (AIDA) at the next level of the experiment.

Whilst the objective of all projects is photography design education, every project requires higher-order thinking (Arneson and Offerdahl, 2018; Krathwohl, 2002) to achieve the learner’s goals. As students engage in the learning process, it is essential to keep them in an active mode of learning by asking probing questions at every stage of the design process for the project.

It is important to note that “action research is a continuous spiral of higher-order thinking processes” till the next level.
References


Loomis, A. (2017), *Figure Drawing for All Its Worth*, 3rd ed., Editora Bibliomundi Serviços Digitais Ltda, available at: https://books.google.co.in/books?id=S5RDDwAAQBAJ&dq=andrewþloomis&lr=


Corresponding author
Keyur Sahasrabudhe can be contacted at: keyur@sid.edu.in

---

For instructions on how to order reprints of this article, please visit our website:
www.emeraldgrouppublishing.com/licensing/reprints.htm
Or contact us for further details: permissions@emeraldsight.com